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NASA PROJECT APOLLO TEST LAUNCH VEHICLE - LITTLE JOE II



**JUNE 1962** 

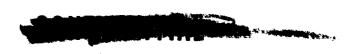
NASA CONTRACT NAS 9-492

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# PROGRAM PLAN NASA PROJECT APOLLO TEST LAUNCH VEHICLE - LITTLE JOE II

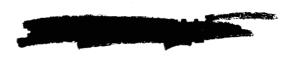
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8 June 1962

NASA CONTRACT NAS 9-492

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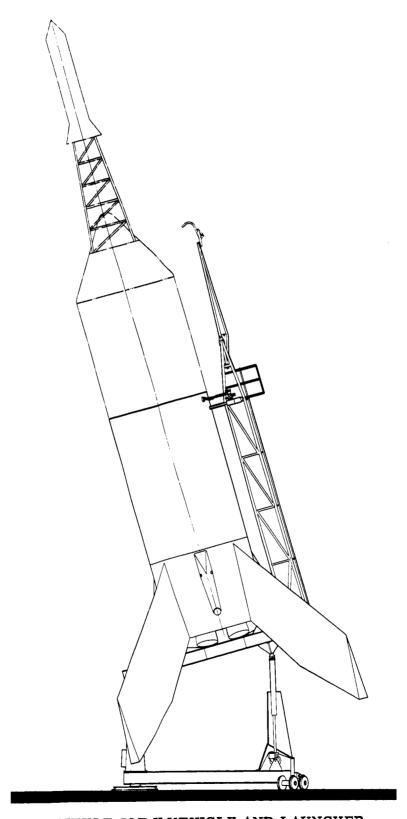
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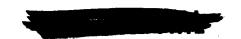
LITTLE JOE II VEHICLE AND LAUNCHER



#### FOREWORD

The Program Plan for the Little Joe II Project was formulated in compliance with 4.5.3.1.1 of the NASA Statement of Work, using the instructions provided in Paragraph 4.3.2.1. The Program Plan is a single source document which brings together all of the pertinent information relative to the management of the Little Joe II Program.

The information contained herein represents the current plans for program activity and will be expanded in more detail as the program progresses.



- 1.0 <u>AUTHORITY</u> Letter Contract Number NAS 9-492, dated 11 May 1962.

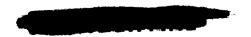
  NASA Project Apollo Statement of Work

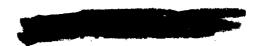
  Test Launch Vehicle Little Joe II
- 2.0 <u>DESCRIPTION</u> The Little Joe II vehicle structure consists of a fore-body, afterbody and four (4) fins. The launcher consists of mast, support pivot frame assembly, support structure, pitch and azimuth actuators, and umbilical arm.
- 3.0 <u>TYPE OF WORK</u> The task will consist of engineering, tooling, fabrication of details, assembly of components, and such support activities as are required to build five (5) vehicles and one (1) launcher. The task will also include support activity for off-site facilities implementation.



## 4.0 GROUND RULES -

- 4.1 Convair as Little Joe II Prime Contractor is responsible for the design, manufacture, assembly, shipment and off-site installation at Cape Canaveral, Florida.
- The design, manufacture and assembly will be accomplished at Convair Experimental Factory, located at Plant I of the San Diego Facility.
- 4.3 A two-shift, 40-hour work week will be employed.
- 4.4 No additional facility, or use of any Government facility, is required for the accomplishment of this task at Convair, Plant I.
- The make or buy policy is to manufacture, machine form and assemble all parts in house. Raw material (skins, extrusions, forgings, etc.) and fasteners (nuts, bolts, rivets, etc.) will be procured from outside sources.
- 4.6 Tool Design and Manufacturing Policy will be established to support a 14-unit program.
- 4.7 Program Management will be accomplished within a project organization which will draw upon the existing Convair organization. The Project Manager will report directly to the President.
- 4.8 PERT, PRESTO and a Cost/Schedule Control Plan will be employed as management control tools on this program.
- 4.9 Go-Ahead date for the purpose of contract performance is 14 May 1962.





## 5.0 STATEMENT OF TASK -

- 5.1 The Contractor shall design, develop, fabricate and deliver the following items in accordance with NASA Project Apollo Statement of Work (Little Joe II) Letter Contract NAS 9-492, and Convair Proposal, GDC-62-114:
  - a. Five (5) each solid, sub-orbital vehicles.
  - b. One (1) each solid, sub-orbital vehicle launcher.
- 5.2 The Contractor shall furnish the following items in accordance with documents listed in 5.1 above.
  - a. One (1) lot documentation.
  - b. One (1) lot services.
  - c. One (1) lot GSE. This item to be the subject of separate negotiations prior to fabrication.
  - d. One (1) lot of spares. This item is subject to the same conditions as stipulated in Item c above.
- 5.3 The Contractor shall conduct and deliver an attitude control system study in accordance with NASA Letter Contract NAS 9-492, dated 11 May 1962.
- 5.4 Convair will be responsible for determining the interchangeability or replaceability classification for all items in accordance with NASA Project Apollo Statement of Work.



- 6.1 Organization - A project-type organization has been established for the primary purpose of integrating organization functions with the projectized management control techniques (See Figure 1). One of the basic requirements for a successful program is an informed management. This end is accomplished by the regular Program Manager Staff Meetings held twice each week. Here, the Project Manager meets with the departmental representatives comprising his staff to review all phases of program status including schedules, PERT reports, budgets, engineering releases, design changes, tooling and production. Problem areas and schedule incompatibilities are discussed individually. Where possible, corrective action is prescribed immediately. If not possible, arrangements are made for subsequent meetings of the personnel concerned and a schedule is established for a report back to the staff. Since each representative is assigned on a full time basis, special staff sessions can be arranged with little or no advance notice to expeditiously resolve problems or realign plans to changed conditions.
- As a result of this project-team approach, a close working relationship has been established between the Project Manager and his staff which extends into program activities at all working levels. This relationship will be expanded by the addition of key personnel specifically to the Little Joe II to avoid any possible dilution of effort. The project-type organization technique has proven to be a major factor in successfully integrating departmental plans with the common objectives of the total program.
- 6.3 Related Budget & Schedule Performance Control -
- 6.3.1 The system of reporting described below has been established to satisfy the need within the organization for weekly reporting of performance to



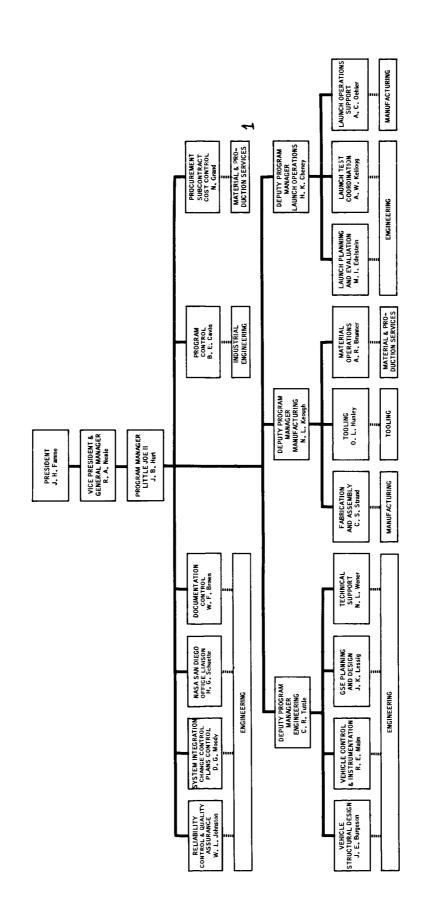


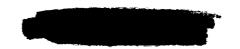
Figure 1. PROGRAM MANAGEMENT

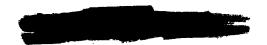


- established budgets and reporting performance to schedule against a common increment of task.
- 6.3.2 Budget allotments for the major areas of manhour and material expenditures will be broken down into weekly increments for the specific scheduled time span in which the activities are scheduled to occur. To this curve, weekly actual expenditures will be plotted, thereby indicating under-, on-, or over-budget conditions.
- 6.3.3 In the area of schedule control, similar to the method used in budget control, spreads of total task required to be completed on a weekly basis will be made in accordance with the time areas indicated in the program master schedule. In the factory area, scheduled hours of task will be the means of measurement. Engineering will be controlled by Engineering Work Order count and Tooling will be controlled by planning and actual tool count. Material, by necessity, will be controlled by budgeted dollar value required and received in-plant on a weekly basis.
- 6.3.4 The Program Manager and his Staff will review the above information on a weekly basis and thereby determine at an early date any area of excessive expenditure or lateness of schedule. Specific assignments of corrections will be designated, at these meetings, and will be investigated and reported on by the appropriate staff member.

#### 6.4 Change Control -

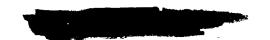
6.4.1 Change control will be employed to assure the orderly and expeditious handling of all changes to Engineering design, specifications, and program plans. Changes required or requested will be evaluated, to confirm their desirability, necessity, and effect by the System Integration Staff Member or his delegated alternate. If approved for processing the Change Board comprised of representatives from Engineering, Material, Tooling, Program Control, Manufacturing Control, Factory





and Contract Department, and Program Manager's Staff as required will process the changes and will be responsible for the origin and maintenance of change history records, coordination of all department activities toward the implementation of changes and the establishment of change schedule and cost estimate. The change board will be responsible to report any problems in schedule, cost, etc., to the System Integration Staff Member for resolution. Every attempt will be made to keep Convair-originated changes at a minimum. Convair will obtain Procuring Agency approval before proceeding with changes requiring a change to the contract.





7.0 MASTER PHASING AND MILESTONE CHARTS - First Vehicle Schedule,
Launcher Assembly Program Schedule, Manpower Utilization and Requirements, and the Milestone Schedule are contained in this section.



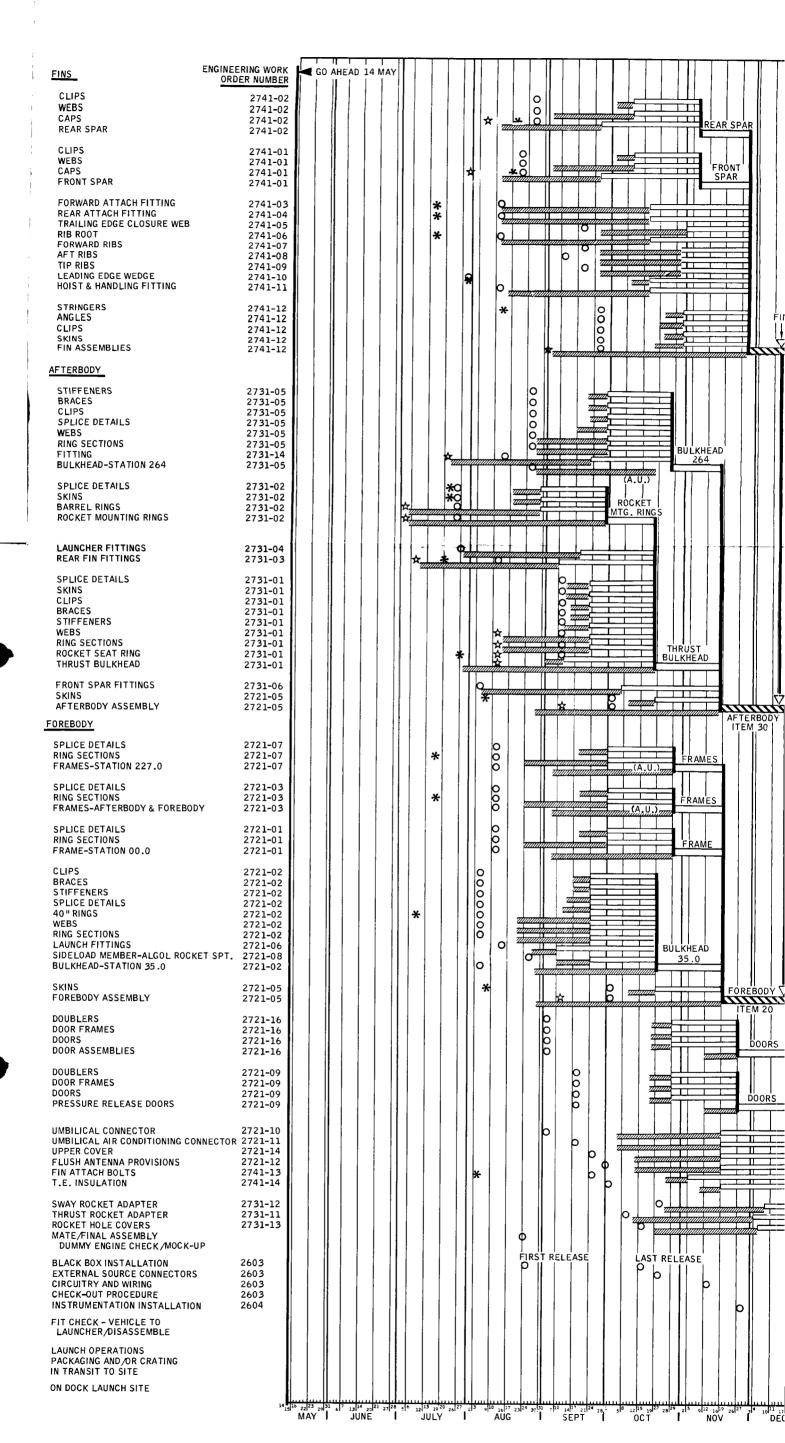


Figure 2. FIRST VEHICLE SCHEDULE

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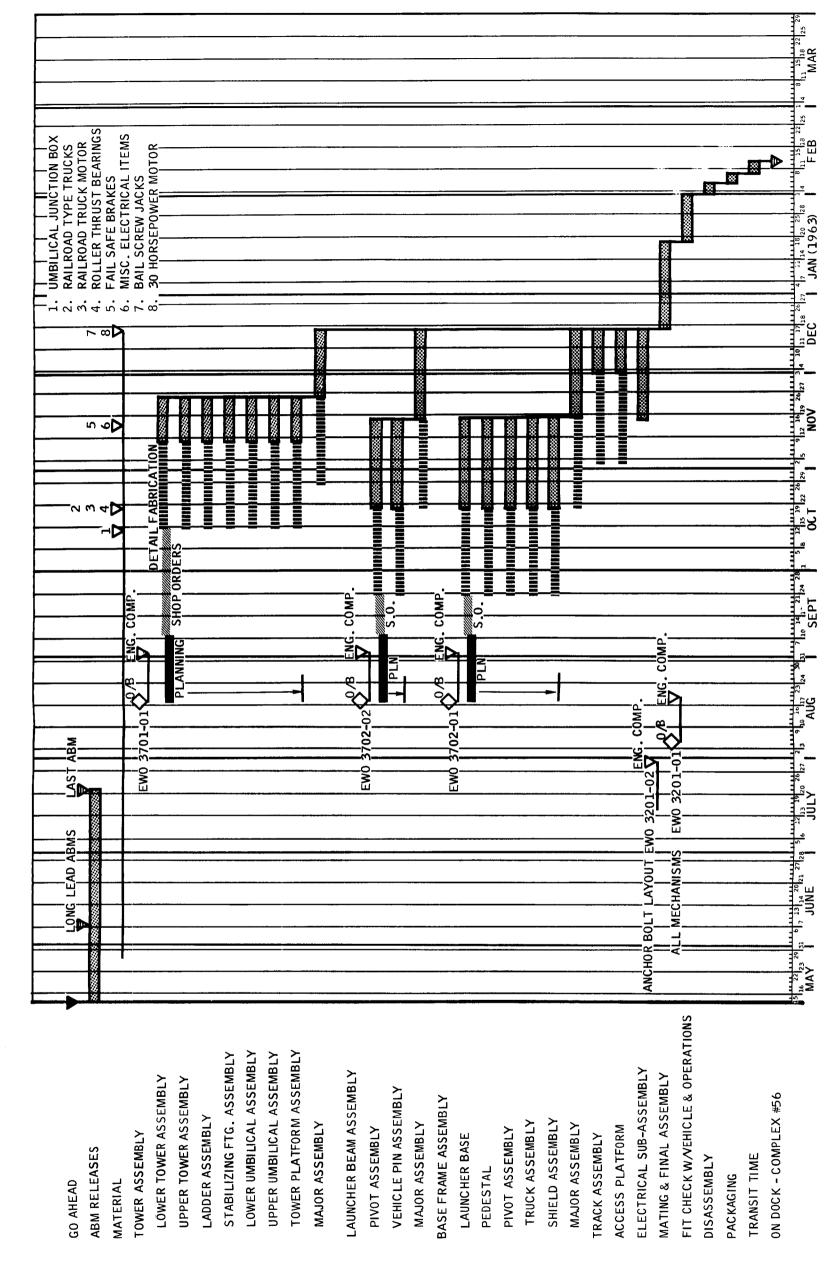


Figure 3. LAUNCHER ASSEMBLY PROGRAM SCHEDULE

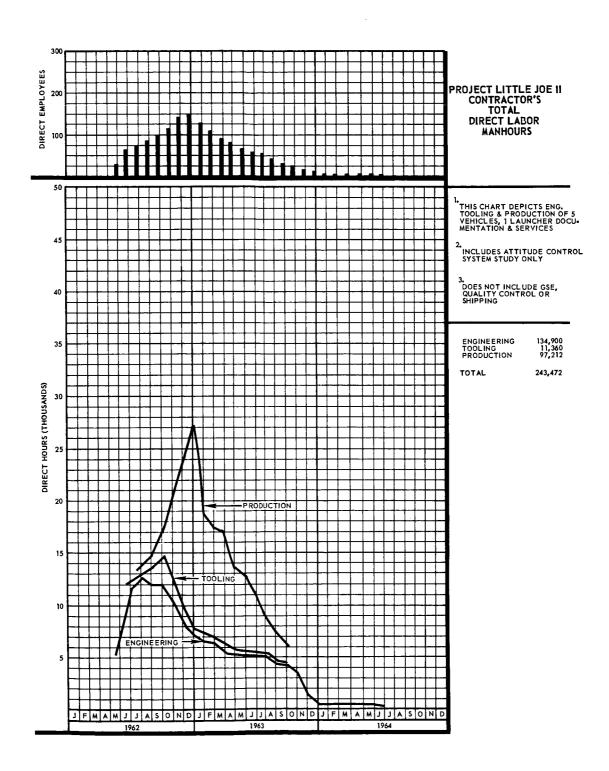


Figure 4. MANPOWER REQUIREMENTS

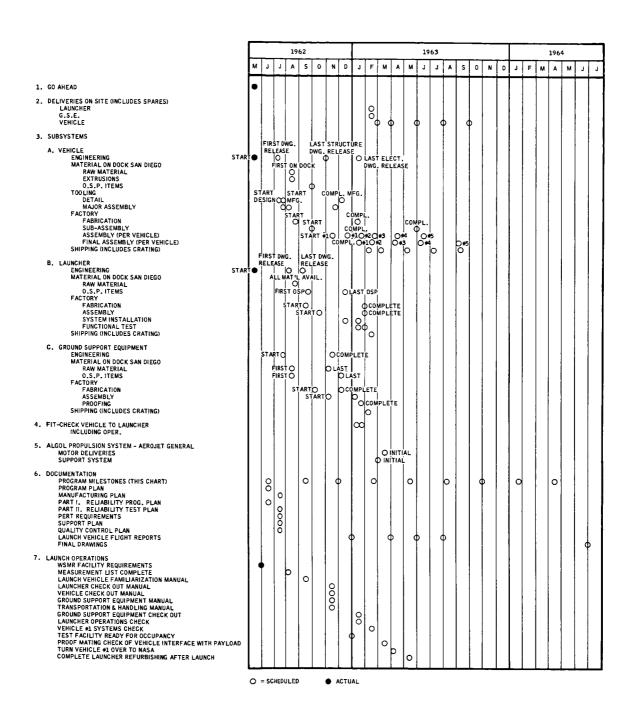
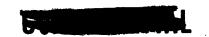


Figure 5. MASTER PHASING AND MILESTONE SCHEDULE

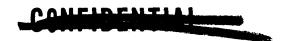


#### 8.0 DESIGN AND DEVELOPMENT -

General Approach - The approach to be followed in the design and development of the launch test vehicles, launcher and ground support equipment is dictated by the relatively short time span between goahead and initial delivery. For this, as well as economic reasons, emphasis will be placed upon simplicity of design for manufacture and assembly. Maximum use will be made of off-the-shelf components, existing commercial raw materials and established design principles. Maintenance and support problems of the vehicle and GSE will be studied as part of the documentation. An effort will be made to minimize the need for special tools.

# 8.2 <u>Launch Test Vehicle</u> Design Approach -

8.2.1 The launch vehicle structure consists of a cylindrical upper and lower body and four fins. The forebody extends from the payload interface to the assembly splice. The afterbody extends from the assembly splice to the base. Both body shells are of semi-monocoque construction, made from aluminum alloy. The assembled length of the body is 154 inches. The structural backbone of the vehicle is the large built-up bulkhead near the base. This bulkhead is essentially a 16-inch thick sandwich-type structure, consisting of upper and lower face plates, cylindrical interconnected thrust members, launcher fittings and fin attach fittings. The face plates react bending and the interconnected thrust cylinders transmit shear similar to a honeycomb structure. The bulkhead fin attachment fittings are designed for the loads of the large 150-square foot fins. The payload interface bolt pattern has been coordinated with North American Aviation using the locations called out on NASA Drawing 10M03206, "S-IV Stage and Instrument Unit Interface Details SA-5" by the George C. Marshall Space Flight Center.





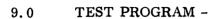
- 8.2.2 The fin size is being studied during the first month of the program and the final configuration will be determined. However, the attach points to the body will remain the same as for the 150-square foot fin.
- 8.3 <u>Launcher</u> The launcher design and development will be a four-step program.
- 8.3.1 The first step will consist of:
  - a. Heat sink studies to determine heat and expansion problems on the structural and mechanical members.
  - b. Dynamic studies to determine the acceptable speeds of traverse and inclination and the impact loads on the launcher.
  - c. Determination of the launcher configuration and procurement of the mechanisms.
  - d. Preparation of launcher specifications.
- 8.3.2 The second step will consist of detail design of the launcher and integration of the electrical and other systems. Heat sink, dynamics, and stress analysis will continue to assure design adequacy.
- 8.3.3 The third step will consist of the manufacture and assembly of the launcher in the shops. The tests as required in the test plan will be performed in this phase. Engineering will maintain liaison with manufacturing to assure design compliance. The launcher will be dismantled and prepared for shipment.
- 8.3.4 Step four will consist of the erection of the launcher in the field, the final wiring, and test of all systems.



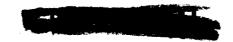


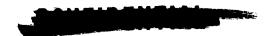
- 8.4 Ground Support Equipment -
- 8.4.1 <u>Console and Electronic GSE</u> The design approach will be to study and determine the system requirements and to select "off-the-shelf" parts and circuitry to adequately perform the function.
- 8.4.2 Environment Control The approach to the heating and cooling problems will be to use the mass and low conductivity of the solid boosters to minimize the load and control problems. The method of insulating the launch vehicle and problems of air circulation will be studied in order to determine the requirements for environment control. Commercial refrigeration and heating units, with ducting and controls to meet the requirements, will be used.
- 8.4.3 <u>Slings</u> Slings will be designed for their application using standard components and factors of safety. The slings will be proof tested to 200% of design load before delivery.





- 9.1 An integrated test plan will be used to monitor and control all phases of testing. This plan details all test parameters and equipment required using PERT techniques for scheduling and control as required. The Systems Integration Staff Assistant will be responsible for all aspects of this plan.
- 9.2 Test plan objectives and ground rules have been established in the following broad categories:
  - a. Engineering tests.
  - b. Reliability tests.
  - c. Quality assurance tests.
- 9.3 Specific tests have been planned and scheduled in the following specific areas:
  - a. Quality assurance and reliability tests.
  - b. Engineering development tests.
  - c. Structural, design verification and GSE tests.
  - d. Subsystem proof testing.
  - e. Vehicle preshipping test first vehicle only.
  - f. Installation and assembly tests.
  - g. Flight readiness tests.



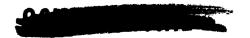


# 10.0 MATERIAL CONTROL -

- Material Department support of the Little Joe II Program will be accomplished with the existing department personnel and basic functional units.

  The program will be managed on a project basis with specific individuals assigned within each section who will control and monitor the program.

  They will work under the coordination of the staff specialist assigned to the Program Manager. Emphasis will be placed on use of streamlined systems and procedures in a projectized approach without duplication of existing operations.
- Material release will be accomplished at the on-board level using an Advance Bill of Material (ABM). Vendor data and spares, wherever possible within contract authority, will be released concurrently with production requirements. All releases will be expedited to the Purchasing Department for immediate procurement action. Complete forecast and purchase parts cost control record will be maintained at the on-board level.
- Weekly and monthly contract status reports will be produced for monitoring on-hand and on-order balances in terms of quantity and dollars. Monthly contract status reports will be maintained as a permanent historical data file. All requirements will be parts listed and submitted to the 705 computer facility. The material release analyst will maintain manual records of requirements and inventory transactions on all high-cost items. Monthly sampling audits will be conducted of all inventory group areas including stockroom control. Stores requisitions for outside purchased and subcontract parts will be prepared manually. Accountability records will be maintained in accordance with contract requirements.





- 10.4 Procurement will be accomplished within the existing Purchasing
  Commodity Groups. However, specific coordinators will be appointed
  in the Raw Material, Systems, and Subcontract Groups to monitor the
  procurement activity and assure action compatible with program requirements.
- Operation. For control purposes a special block of receiving report numbers will be assigned to be used to record materials received for the program. Procedures will be utilized to insure expeditious handling of all parts and material received.
- All material and parts will be stored in a bonded stockroom located in close proximity to the manufacturing area. Detail Kardex records will be maintained to cover requirements, receipts and issues. Limited, cancelled, or rejected items will be handled on an expedited basis. Schedules and requirements will be made available to the stockroom in order that shortage reports can be prepared at this level. Listing of personnel authorized to withdraw material from the bonded stockroom will be prepared. Strict accountability will be maintained on all parts and any apparently excessive usage will be closely monitored.
- All end items will be shipped via the Rose Canyon Shipping Department with special trucks or trailers provided by common carriers via the routing shown in Section 15. Special plans have been made to control all costs. Current planning is to ship the vehicle on a lowboy trailer, the launcher on a special lowboy machinery trailer, and fins and related equipment in a van.





- engineering, tooling and factory requirements, and of associated indirect personnel, is in consonance with the capability available within Convair (see Figure 4). The manpower loading to accomplish design and to manufacture test vehicles occurs in satisfactory phasing relationship with further loading to attain schedule commitments. Experience is retained and test program performance verification of design requirements supports the production build-up within estimated program costs.
- 11.1 <u>Milestone Schedule</u> The schedule shown in Figure 5 assembles the key check points of the Little Joe II Program. This chart will be used as an aid to management for overall program status.



### 12.0 MANUFACTURING -

- 12.1 Use or expansion of existing Government-owned facilities for production of Launch Test Vehicle and Launcher is not planned. Only Convair facilities will be utilized for this program (see Figure 6). These facilities have the necessary capability. All manufacturing and testing facilities will be shop loaded for the total program to assure availability and capacity.
- Preliminary manufacturing breakdown of the airborne units is as follows: (See Figure 2 for First Vehicle Schedule.)
  - a. Detail fabrication.
  - b. Subassemblies:
    - (1) Bulkheads.
    - (2) Fin spars.
    - (3) Fin skin and stringer assemblies.
    - (4) Rocket mounting rings.
  - c. Major assemblies:
    - (1) Forebody.
    - (2) Afterbody.
    - (3) Fins.
  - d. Major mate all components.
  - e. Final assembly at launch site.
- 12.3 Preliminary manufacturing breakdown of launcher unit is as follows:

  (See Figure 3 for detail Launcher Schedule.)
  - a. Detail fabrication.
  - b. Subassemblies.
  - c. Final assembly.
  - d. Fit check of launch vehicle and launcher.



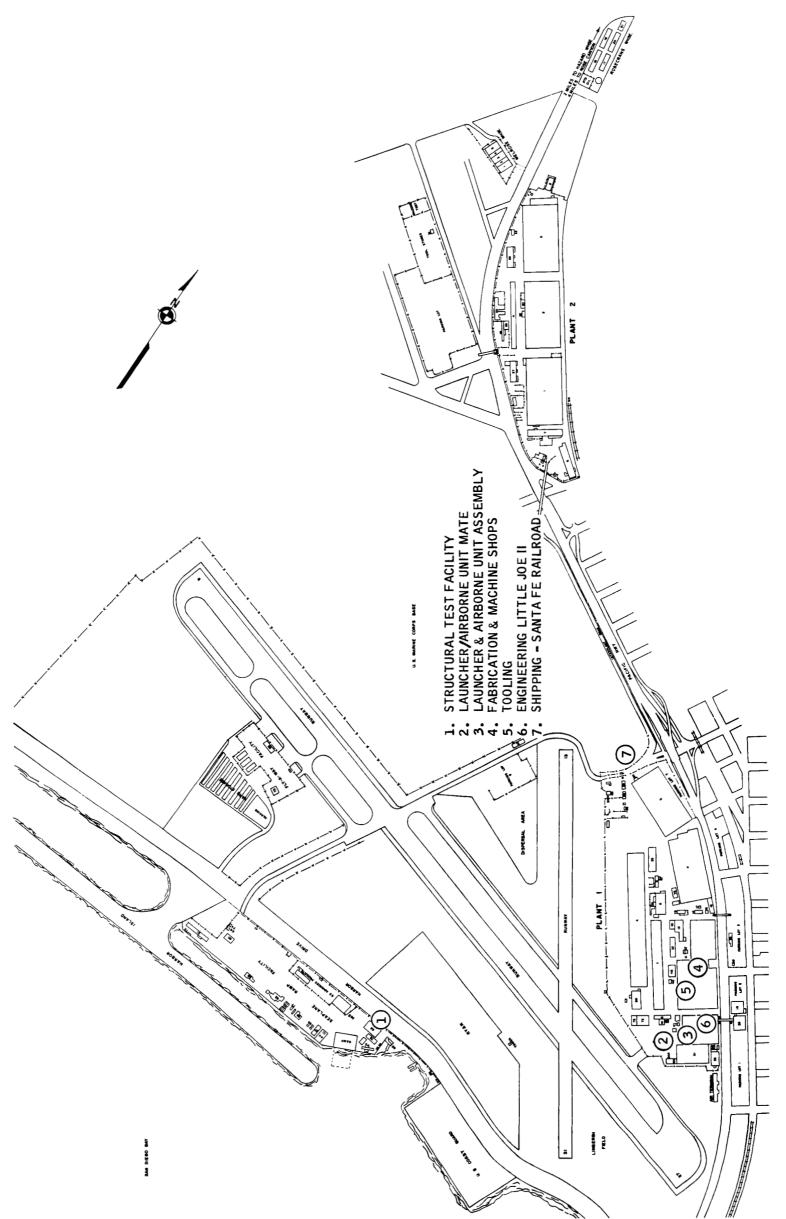


Figure 6. PLANT LAYOUT - CONVAIR SAN DIEGO



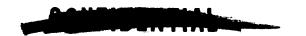
- 12.4 Tooling policy is based on limited production requirements and rapid incorporation of engineering changes. The planning and tooling approach will be guided toward achievement of production schedules through minimum effort and make use of worker skills rather than introduce the complication of a completely tooled production program.
- 12.5 Detail layouts for the factory will commence at the completion of tool engineering. Production breakdown and all facility sizes are determined. The objective of the plant layout will be to provide exact space assignment for all facilities, tools, equipment and indirect support. To this end, processes by which materials flow, the sequence of work flow, machinery and equipment required for planned production, and the location and arrangement of indirect operations are essential. The practical aspects of other factors, such as building structure, power, air, lighting, and safety will be reflected in this approach.
- 12.6 Certain specialized facilities will be required to support manufacture of details, subassemblies and major components, and also for major major and final assembly. These facilities are defined as manufacturing aids. They include such items as platforms, special stands, handling cradles, load bars, etc.

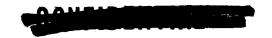




## 13.0 QUALITY CONTROL -

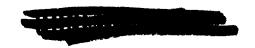
- 13.1 The Quality Control activities for Little Joe II Program are directed and coordinated by a General Supervisor. He reports to the Manager of Quality Control for overall direction and coordinates program activities with the Program Manager and the Reliability/Quality Assurance Staff Assistant.
- 13.2 To effect optimum control, the Convair Quality Control program is directed toward all phases of design, manufacturing, test and checkout, shipping and operational use. The program is developed around the requirements of MIL-Q-9858 and NASA Quality Publication 200-2 and is oriented toward close coordination with Engineering Reliability.
- 13.3 Quality Control activities are concentrated in three principal areas of responsibility, i.e., quality assurance, inspection, and off-site quality assurance.
- 13.4 Quality assurance is directed primarily toward establishing and maintaining program controls through such activities as documentation, stamp control, sampling plans, failure analyses and record maintenance. Also included in this area is process control, test equipment maintenance and calibration, vendor quality evaluation, design review, material review, corrective action and the Reliability Problem Status Review Committee.
- Inspection is responsible for all phases of inspection including mechanical, functional and system checkout. The receiving inspection function performs a detailed first article test on each original receipt of function components. The first article test is a critical inspection, both visual and functional, for possible quality and/or design deficiencies. Subsequent receipts of the same component are subjected to a functional test to verify their operating characteristics under ambient conditions.





Fabrication inspection is accomplished by detail part inspection and progressive inspection of assemblies, components and installations throughout all phases of manufacture. Evidence of inspection for acceptance is maintained by inspection stamping of the material, production planning paper and procedural check sheets. System checkout inspection is planned into the normal manufacturing sequence to insure the operational integrity of the operating systems.

13.6 Off-site quality assurance is a combined quality control and inspection function developed to coordinate all Quality control activities at the off-site base. The activities performed include verification of component and system tests and checkouts. Failure analyses and reporting of malfunctions occurring at the off-site facility is also a function of this activity.





- 14.1 Spares and Ground Support Equipment Requirements -
- 14.1.1 The Contractor shall establish and implement program of spare parts selection, recommendation and stocking that will insure availability of spares in sufficient range and scope. Trained personnel, experienced in spares and GSE, will coordinate with the engineering acitivity for determination of proper support requirements. The philosophy of selection and recommendation will be based on the various program factors, including the program production rate, sequence of launches, inherent reliability and concept of design. Support will be full range from basic materials necessary for on-site repair to those systems of complicated design. Detail components of reparable units will be provided when repair is considered advantageous and justified at launch site.
- 14.1.2 At the earliest point in which design is sufficiently defined, negotiations will be entered into with NASA for procurement authority of both spares and GSE. The results of these negotiations will be reflected in the Hardware List which shall be maintained in current status.
- 14.1.3 It is anticipated that the majority of all parts ordered will be used by the close of the program. However, should stock remain, full consideration will be given to proper and economical disposition. This will include, but not be limited to return for use on other programs or to the manufacturer for possible resale.

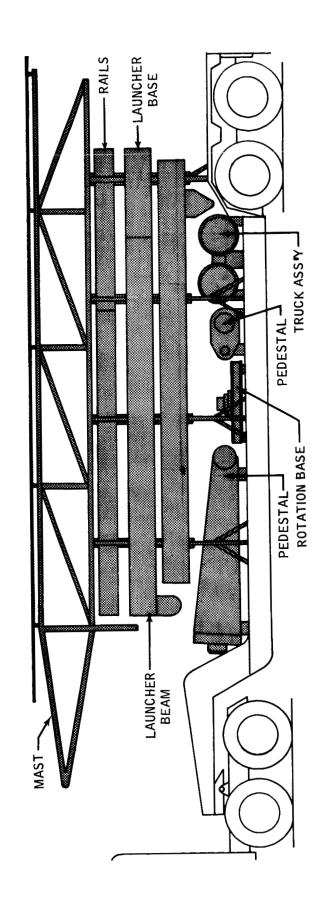


Figure 7. LAUNCHER ASSEMBLY

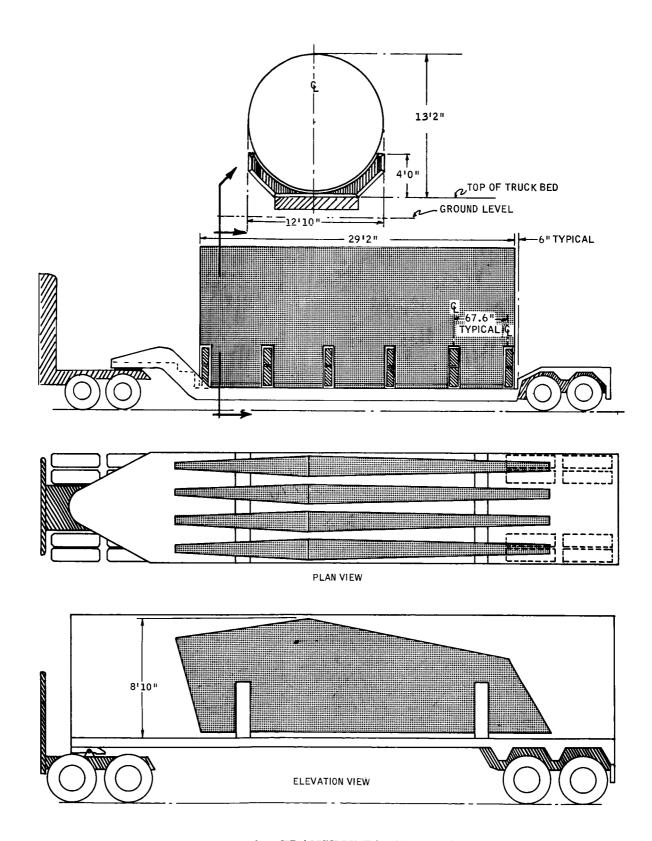


Figure 8. TRANSPORTATION PLAN



Loading - Transportation of the body and fin units of the launch vehicle will be accomplished by motor carrier service. The launcher will be shipped by truck routing using standard trucking equipment (Figure 7). The body will be loaded on a tandem axle lowboy machinery trailer. The fins will be transported in a standard van, Figure 8. The motor carrier service will outfit the lowboy trailers required to transport the body units. The wooden cradles necessary to support the body during transit will be supplied by the carrier.

## 15.2 Routing -

# California - Arizona:

Highway 395 to 60 to 99 to 111 to 195 to 60 and 70 to Desert Center, county road to Parker, Arizona, 72 to Hope, 60 and 70 to 89 to 93 to 84 to 80 to 86 to New Mexico state line, underpass east of Wilcox, turn back left on second fork of 666, approximately one block to dirt road, right on dirt road, comes out center of town in Bowie.

#### New Mexico:

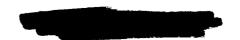
State 14 to U.S. 80 to El Paso.

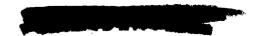
#### Texas:

El Paso U.S. 80 east to Weatherford, south on State 171 to Cleburn, then east on State 110 to Grand View, east on Farm Roads 916 and 66 to Waxachachie, then east on U.S. 287 to Ennis, north on State 34 to Greenville, east on U.S. 67 to Texarkana.

#### Arkansas:

U.S. 82 at Texarkana through to Missippi state line.





# Mississippi:

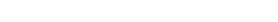
East on U.S. 82 to Mayhew, south on 45 W to U.S. 45, south on 45 to Lauderdale, then take farm road to Kewanee, at U.S. 80. Then U.S. 80 to Alabama state line.

#### Alabama:

East on U.S. 80 to Montgomery, Montgomery to U.S. 231, south on 231 to Dothan, south on U.S. 53 and 71 to Marianna, Florida.

#### Florida:

Southeast on Highway 90 from Marianna to Tallahassee, south on 319 to Wakulla, Southeast on 98 to Perry, east on 27 to Mayo, north on 51 to Live Oak; across Suwannee river bridge, 18 feet high; south on 129 to Branford, east on 27 to High Springs, south on 27 to Ocala, south on 301 to Belleview, south on 27 to Clermont; east on 50 to Indian River City, north on 1 to Titusville, then east on 402 to Cape Canaveral.



C-1400 (50)